Changing university culture towards reduced air travel – Background Report for the 2017 Virtual Conference on University Air Miles Reduction

Janisch, Tscherina ; Hilty, Lorenz

Abstract: This literature report has been written as preparation material for the Virtual Conference on University Air Miles Reduction, taking place between October 30th and November 6th, 2017. The Virtual Conference project has been initiated by ETH Zurich and the University of Zurich under the patronage of the IARU network. It is only possible thanks to the great support from the participating universities.

Changing university culture towards reduced air travel

Background Report for the 2017 Virtual Conference on University Air Miles Reduction

Authors:
Tscherina Janisch, ETH Sustainability
Prof. Dr. Lorenz Hilty, University of Zürich
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ETH Sustainability

Content

1 Foreword

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2 Motivation

The implications of greenhouse gas emissions for climate change are well known. So far, 136 governments have ratified the Paris Agreement, aiming to keep the global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees (UNFCCC, 2015). To reach these goals, significant reductions in greenhouse gas emissions are urgently needed. However, global emissions are still rising. Also international air traffic increased significantly during the last decades (ICAO, 2015). “Academic researchers are among the highest emitters, primarily as a result of emissions from flying to conferences, project meetings, and fieldwork” says a recent study of the Tyndall Centre for Climate Research (Le Queré et al., 2015). As data from different universities show (e.g. ETH Zurich, Oxford University, etc.), the main contribution of total carbon emissions stems from air travel (short and long haul flights) (Survey ETH et al., 2016).

A university thrives on the exchange of knowledge and cooperation between its own members and with other educational and research institutions. International collaboration and networking are often strategic targets of universities. While physical attendance of conferences or projects meetings during business trips help develop and embed academic research, collaboration and learning – we must ensure that this is balanced against the commitment to reduce overall institutional carbon emissions. Hence, we face a dilemma between strategic targets and interests. We hereby determine the main conflict to be addressed between the international orientation and performance measures of universities and their commitment to reduce institutional carbon emissions of universities on a big scale. Thus, we launched the project Virtual Conference on “University Air Miles Reduction” in order to discuss this dilemma and try to find alternative solutions together.

By organizing a showcase of such a Virtual Conference, ETH Zurich will examine and demonstrate the current opportunities and limitations of videoconferencing and virtual collaboration formats and systems. This includes the translation of current set-ups and known sessions of standard physical scientific conferences that require physical attendance into virtual analogs (e.g. seminars, break-out sessions, workshops, networking aperitif, etc.). In this input report, we present a background study that will serve as preparation for the Virtual Conference that we organize together with our partner universities in late October 2017.

3 Analysis of the current state

Based on a literature review and a survey conducted among over 35 peer universities in May 2016, an analysis of the current state could be conducted (Survey ETH et al., ETH 2016).

3.1 The scale of increasing air travel worldwide and in academia

GHG emissions of international flights accounted for 4.9% in 2005 and they are often not included in national GHG-inventories today, which means that they are not counted for overall emissions of a nation (Lee et al., 2009).
In an annual global statistic by the International Civil Aviation Organization (ICAO), the total number of passengers carried on scheduled services was assessed. One option is to express passenger traffic in terms of total scheduled revenue passenger-kilometers (RPKs). It is calculated by multiplying the distance of scheduled flights times the number of passengers. The global number is then obtained by adding up all these values. International scheduled passenger traffic increased by 7%in RPKs in 2015 while domestic scheduled passenger traffic grew by 7.3% in RPKs from 2014 to 2015 (ICAO, 2015). Very few data is available on this topic over several years but it would be interesting to assess this development over a longer time interval.

Table 1: Development of passenger traffic (2014-2015)

Factor	Value (2015)	Relative Increase (2014-2015)
Number of passengers carried on scheduled services	3.5 Billion	+ 6.8%
Number of departures	34 Million	+ 2.6%
Passenger traffic (passenger kilometers)	6601 Billion RPKs	+ 7.1%

Source: ICAO, 2015 (Webd)

The regional distribution of scheduled traffic varies. The strongest growth of passenger traffic is observed in airlines from the regions of Asia/Pacific, Europe and North America (ICAO, 2015).

Table 2: Growth of passenger traffic by regions (2014-2015)

Region of the airline carrier	Percentage of world traffic (2015)	Relative Increase (2014-2015) Growth rate
Asia/Pacific	32%	9.2%
Europe	27%	5.8%
North America	25%	5.1%
Middle East	9%	10.3%
Latin America/Caribbean	5%	7.8%
Africa	2%	2.4%

If, as the International Civil Aviation Organisation predicts, emissions from international aviation grow by 300%, flights could be responsible for 22% of global GHG emission by 2050 (ICAO, 2015).
In the context of climate change, and with the goal of reaching the 2 degrees target formulated by the Intergovernmental Panel on Climate Change (IPCC), several measures to reduce overall air travel are considered (Pachauri et al., 2015). Considering expected economic developments and population growth, the 2 degree target can only be met if all sectors and actors contribute their share to the reduction.
Consequently, there is a broad consensus that international aviation needs to contribute to fulfilling the goal of the Paris Agreement and it can be expected that these emissions will inevitably be accounted for. However, scientists and students are often confronted with the dilemma to become 'frequent flyers' for their successful academic career. Attending international conferences, joining global research groups, or running fieldwork or summer school programs abroad are often key factors for a successful scientific career – in particular for young scientists.
While international collaboration in research has increased significantly, CO_2 emissions from business travel are often a significant proportion of a university's total carbon emissions. According to internal records, they add up to approximately 90% of total carbon emissions for ETH Zurich. The hurdles to reduce these emissions are huge because ETH Zurich is an internationally well-connected and prestigious university that heavily depends on international exchange and cooperation on a global level.

3.2 The call for a change in university culture gets louder

Nevertheless, an increasing number of scientists publicly announce this dilemma and debate about necessary changes in university culture. They discuss the paradox of increased conference business to protect the environment as "regular long-distance flying can easily triple an academic's carbon footprint" (Grémillet, 2008). Some others call for a roadmap to reduce carbon emissions of universities (Le Quéré et al, 2015) or they expect more responsibility of universities and conference organizers by optimizing conference locations based on the participants' location in order to reduce related carbon emissions (Stroud & Feeley 2015). The scientific community is risking to lose credibility if scientists do not walk the talk in terms of emission reduction following government targets (Le Quéré et al, 2015). With respect to climate and environmental politics, individuals face the "classic dilemma between personal restraint and energy-demanding public involvement" and the decisions might be guided less by environmental awareness but more by ambition. This can turn the most renowned and engaged scientists in climate politics into 'constant flyers' (Grémillet, 2008).
The European Commission stated that "human resources are, to a large extent, the key of research efforts, excellence and performances" and they consider the number of researchers and their mobility as two important factors of this issue (European Commission, 2003). Aiming at enhanced research mobility between countries, academia and industry, various initiatives have been established (European Commission, 2009). However, many studies criticize the assumption that mobility has a positive effect on career development and advancement and research performance: Some studies suggest that mobility of researchers is linked to higher productivity and more citations (De Filippo, Casado & Gomez, 2009) while others suggest that job mobility of researchers does not affect their publication output and citation levels (Cruz-Castro & Sanz-Menendez, 2010; van Heeringen & Dijkwel, 1987). Besides the questionable correlation between mobility, productivity and publication output (quantity and quality measures through publication and citation rates), the need for distant, frequent and international travel for research performance is not proven. Although completely avoiding all travels is not an option, travelling might not be of key importance anymore due to improved connections and collaboration in national and international networks through improved virtual communication and diverse team and meeting setups (Aksnes et al., 2013). The conflicting results of previous studies suggest that the effects of mobility on scientific performance and publication output are complex and questionable.

Based on scientific findings and following national policy targets, academic administrations and student organisations also request concepts towards a reduction of greenhouse gas emissions from air travel (ETH Zürich 2016, Nachhaltigkeitswoche 2016). A list of initiatives to reduce CO_2-emissions from academic business trips by airplanes can be found in Appendix C.

3.3 Partner universities call for reduced business travel

Several partner universities in three academic networks share the request to reduced business travel emissions. The findings from a survey among our peer universities also illustrate an increasing request for action when looking at exemplified CO_2 emission shares of air travel. In May 2016, the four offices for sustainability at ETH Zürich, ETH Lausanne, University of Zurich, and University of Basel asked their colleagues within the IARU[1], ISCN[2] and Copernicus[3] networks to share experiences related to business travel of their affiliated universities or institutes. This unpublished survey is in the following referred to as ETH et al., 2016. In total, 38 respondents from 34 different academic institutions and 14 countries completed an online survey. According to the respondents, 21 out of 34 universities report that their institutions collect some information on their national and/or international business trips of staff, including the transport mode. 18 respondents mentioned that their institution is calculating GHG emissions related to business trips and out of 16 respondents, seven announced a share of less than 25% of the total GHG emission balance. In contrast, four respondents indicated a share of more than 50% at their institutions. This is in line with some data found in literature, in which long-distance flying can triple an academic's carbon footprint (Grémillet, 2008). Most of the institutions only appoint 0-25% of total emissions to train, car and bus, each according to our internal survey conducted in three different university networks. Although these numbers represent only a first insight, the need for a changing academic culture towards reduced air travel seems to become more and more relevant for many universities. Most of our peer universities share the request to reduce emissions caused by international business travel. At least these results illustrate the potential to avoid unnecessary business trips or to use different modes of transport for shorter distances (e.g. within Europe).

3.4 The dilemma

In summary, research evaluation and performance measures often contain a main factor of international collaboration through co-authored projects or conference participation etc. This leads to continuously increasing air travel from university staff in order to participate in meetings, conferences or common fieldwork. So overall, the problem statement can be summarized to:
There is a dilemma between strategic targets or interests at universities of which one is to reach the highest possible performance while reaching sustainability targets and reducing related CO_2 emissions and thus air travel. Additionally, there are more individual dilemmas related to moral decisions of whether or not to fly. Why do people with pro-environmental attitudes fly although their behavior and flying activity harm the earth? These obvious tensions between normative positions on climate change and travel activities evolve as people want to create and maintain direct face-to-face contact with others and they commit to different obligations in the family, social and work domains in an increasingly technological, hypermobile and globalized world (Hales & Caton, 2017).
So why do these problems actually exist? What are reasons for the complex flyer's dilemma and how can we raise awareness to overcome it?

[1] http://www.iaruni.org/
[2] https://www.international-sustainable-campus-network.org/
[3] http://www.copernicus.eu/

4 Reasons for increasing business travel among scientists and students

Many university members fly in order to maintain international contacts, foster international exchange and get new ideas for their projects or research. The main reason for flying, however, seems to be the attendance of scientific conferences as Richard Parncutt from University of Graz in Austria stated (Academic Flying Blog 2017). There are few publications treating the topic of motivations, expectations and choice of conference attendance or conference tourism and many of them do not directly relate to attendance of scientific conferences. A more extensive list can be found in Appendix B.
According to Oppermann and Chon (1997), the main motivators and most important factor to choose and physically attend specific scientific conferences are networking or personal interaction and the program selection or setting.
Additional factors that influence convention participation have been found: Activities and opportunities as well as program content that can provide educational value or support career enhancement play an important role in conference selection. These are followed by cost and external activities such as visiting friends or family or the surroundings (Tanford et al., 2012). Another key motivator for conference attendance is convenience and travel ability that consists of location's accessibility and attractiveness (Zhang et al., 2007). They are also influenced by costs or financial situation as well as infrastructure (e.g. offered accommodation), destination or location of the conference, which also have an impact on conference attendance (Yoo & Chon, 2008).
In a modification of Oppermann's original scheme, Zhang et al. (2007) suggested to group these factors into the following four basic dimensions:

- Association and conference factors
- Location factors
- Personal and business factors
- Total cost factors.

Further benefits or expectations that have to be fulfilled at conferences are the following: Many attendees enjoy exploring the world and different realities and they are interested in building up an international network and establish valuable partnerships. Such diverse contacts can lead to participation in international cooperation, projects and publications. Furthermore, unconditional exhibition or conference hall browsing are key for informal less arranged contact. Finding solutions together is a clear advantage of physical conferences because the potential of people in your field or outside your field is huge and assembled in one place, which can give researchers very diverse valuable insights. In addition, one can learn beyond the own field of interest. This is key for prestige and success, international fame and respect. All these points are especially important for young researchers that are not well known and established in the research community yet (Mair & Thompson, 2009; Severt, Fjelstul, & Breiter, 2009; Yoo & Chon, 2008, 2010; Yoo & Zhao, 2010).
Additionally, conference organization is a very profitable business for publishers and organizers so generating income and prestige for hosting institutions and societies is another function of scientific conferences. In order to reach real effective intellectual exchange it is vital to have a clear purpose and objectives for meetings and to prepare them well in advance (Grémillet, 2008; The Guardian, 2017).

5 Measures to reduce business air travel within the scientific community

After describing why this topic is relevant, important and urgent, we now continue with listing specific recommendations in order to overcome this dilemma and to help reduce the carbon footprint of universities. This chapter is a summary of possible measures, based on literature research and a survey conducted at our partner universities in different networks (Survey ETH et al., 2016). It resulted in a list of initiatives and recommendations from partner universities.
To structure these measure we use the four categories as suggested in the "Framework Concept" of the Mobility Platform of ETH Zurich (Mobility Platform ETH, 2016). This concept suggests a process of designing potential pathways for reducing GHG emissions within ETH Zurich which take into account the governance structure of ETH that is characterized by very high autonomy of the 16 departments
The categories of measures to reduce the environmental impact of business travel are as follows:

- Regulatory measures
- Non-regulatory measures
- Changes in enabling conditions
- Compensation schemes

5.1 Regulatory measures: e.g. carbon taxes

Regulatory measures have a normative character and are set in a top down manner: they include carbon budgets, specific restrictions or pricing GHG emissions from air travel.
Some studies evaluate the effect of a carbon or kerosene tax using the concept of price elasticity or similar ideas. For example, Tol (2007) analyses the impact of a carbon tax on international tourism, of which conference tourism builds one major part, according to Høyer and Næss (2001). However, the willingness to pay for such academic air travel is quite high because the university members do not have to pay for their flights themselves and they consider travelling as really important for their performance and success.
The environmental effects of taxation of airline carbon emissions for the US have been estimated (Hofer et al., 2010). According to the aggregate analysis, a fare increase due to emission taxes would lead to a reduction in airplane passenger-miles in the US and an increase in automobile passenger-miles in the US. This relates to the air-automobile substitution effect that indicates that "potentially sizeable increases in automobile traffic and related emissions may reduce the environmental benefits of air travel carbon emission taxes".
Carbon budgets are broken down from an overall greenhouse gas emission goal and each organizational unit has a clearly defined emissions budget per year. Each unit has the freedom to decide which specific measures they use to stay within their budget boundaries.
Advantages are clarity on the specific target, flexibility for implementation and the ease of monitoring. "The main challenges for setting carbon budgets are i) to set the criteria for breaking down the overall emission target into specific budgets and ii) time consumed for negotiating these budgets" (Mobility Platform ETH, 2016).

Restrictions can be set at the type of flight (e.g., restricting business or first class tickets), the person who flies (e.g., reducing the number of flights allowed to master students per year), the minimum distance (e.g., flights for less than 700 Km with a potential train connection are restricted) or for specific destinations (Mobility Platform ETH, 2016). Such instruments have the advantage that they are "clear, one-time measures and are easy to implement and monitor". However, top down restrictions might not be useful in organizations with a high degree of autonomy at the organizational units (Mobility Platform ETH, 2016).

5.2 Non-regulatory measures: e.g. cultural aspects

Non-regulatory measures promote voluntary changes for example by awareness campaigns or setting reward mechanisms.

Despite the relatively large number of publications dealing with potential alternatives to business travel, there are relatively few tangible initiatives towards reducing academia's carbon footprint from flying. A lot of the measures aim at triggering a cultural change or raising awareness. One initiative of this category worth mentioning is the Academic Flying Blog[4]. It aims at voluntary self-commitment of researchers to decrease their personal air travel and thus reduce their individual business-related carbon emissions. This initiative creates awareness by growing a list of academic supporters of their cause from universities around the world. This union of researchers then tries to change something in the culture of the academic world. It aims at offering alternative conference settings and at raising awareness towards the topic through social media, news coverage in major media and different meetings. This movement tries to build up a community that starts reporting and monitoring business travel while actively avoiding unnecessary business travel on a voluntary basis. In this context, they published principles for honest recording on the new aviation agreement (Academic Flying Blog). The movement of the Academic Flying Blog also upholds a list of academic supporters[5].

Reward mechanisms are positive incentives that may trigger a behaviour change. They include a monetary bonus for those who drastically reduce air miles or handing out prices for best practices. However there are disadvantages: e.g. reward mechanisms are not necessarily sustainable ("one can increase air travel again the year after getting the reward"). Additionally, reward mechanisms can be considered as "perverse incentives" since they are available to people with a high flight record (Mobility Platform ETH, 2016).

5.3 Changes in enabling conditions, e.g. video conferencing (VC)

This category of measures focuses on changing context conditions that promote air traveling (reduce wrong incentives). There are a variety of suggestions targeted at changing the current conference setups.

Some authors propose to hand over more responsibility to academia and conference organizers by choosing central conference locations in an optimal way to reduce maximum carbon emissions (Stroud & Feeley, 2015) or by only holding fewer conferences. Another option are multiple sites conferences as organized in Nagoya (Japan) and Davos (Switzerland) in 2012 where both conference locations were connected by video conference systems (Coroama et al., 2012). A similar approach with multiple connected hubs was tested 2017 and will be scaled up in 2018 for the Global Arts and Psychology Seminar (see appendix C for more details).

Additionally, there's an increasing offer of and call for virtual conferences. This can potentially substitute travel by using more technology for virtual communication and collaboration and the related dif-

[4] https://academicflyingblog.wordpress.com/

[5] https://docs.google.com/document/d/14NZh0bZW2jB0qXjt-pl5A2_JfHtErQhxq06ZFd61sN8/edit

ferent views of business or industry and academia (Douglas, Lubbe & Fabris-Rotelli, 2013). Meeting virtually in a global workplace in order to avoid air travel is also becoming more important in order to understand the future of global business (Lichtman, 2006; Strengers, 2015). The emerging role of ICT-based (information and communication technology) virtual communication in various organizations impacts travel patterns and leads to higher virtual collaboration, flexibility and mobility. Virtual meetings are shown to prevent pollution and lead to reductions in carbon emissions (Arnfalk, 2002; Coroama et al., 2012).

Comparing virtual and real conferences and evaluating the real benefits of video conferencing (VC) systems yields the following outcome (adjusted from Le Queré et al., 2015). The main benefits of face-to-face conferences are personal interaction or contact and networking, which help to build commitment and trust and conference attendees can meet new people. Furthermore, reaching agreement during decision-making processes seems to be easier and more likely in face-to-face meetings than in the computerized conferencing mode using web-based conferencing systems (Hiltz et al., 1986). Performance of virtual teams using computer-mediated communication systems is lower compared to traditional face-to-face teams because of different reasons. Firstly, relational links among team members significantly contribute to the effectiveness of information exchange. Secondly, members of face-to-face team report higher levels of satisfaction despite exhibiting similar levels of communication effectiveness (Warkentin et al., 1997).

Technology cannot fully replace the power of direct interaction. Besides, online interaction and collaboration works ideally between people who know each other personally and have good relationships. This shows that physical scientific conferences are still necessary and important but that they could be reduced and participation can be prioritized better. Additionally, programs should be adjusted to increase time available for face-to-face discussions, brainstorming and important networking at the event itself while already digesting content before the event start. Additionally, the conference content should be made accessible publicly via live web-casts and related document sharing so more people can profit from the provided information, e.g. scientists from poorer countries or unrelated fields (Grémillet, 2008; Le Queré et al., 2015). This implies that the interaction experience of virtual teams and meetings has to be actively improved in such virtual conference settings in order to reach high participant satisfaction and commitment. Additionally, synchronous video conferencing is most effective if supported by other (including asynchronous) technologies for virtual collaboration, such as data and document sharing or real-time chat functions.

A variety of technologies that provide audio and video connection at the same time are available. The provided VC technology can be divided into four practical categories, considering its complexity and reach:

- Laptop-based or desktop-based with video camera
- Meeting room, view on all
- Meeting room, zoom in on active speaker
- Room-based solutions

As a basis for the video conference, more detailed information can be found in Appendix A. Topics are technical settings for VC, advantages and disadvantages as well as the infrastructure and equipment of our partner universities.

5.4 Compensation schemes

In the framework of the United Nations Framework Convention on Climate Change (UNFCCC) there is plenty of experience with the use of compensation mechanisms through the flexible mechanisms of the Kyoto Protocol, especially the so-called Clean Development Mechanism (CDM). In addition to these mechanisms and in parallel, the so-called “voluntary market” has evolved during the past two decades (Mobility Platform ETH, 2016).

Carbon offsets have been increasingly purchased in an effort to compensate emissions from aviation by research communities. However there are many ethical and technical issues with carbon offsets (Anderson 2012), and they do not address the issue of research credibility as a result of both professional and personal choices (Nordhagen, 2014). Offsetting as a transition mechanism in the 1990's and early 2000's towards a future with reduced aviation emissions might have been appropriate. However continued use of offsetting instead of reductions in flights contributes to the continued growth in the aviation sector, which is inconsistent with mitigation targets post-2030 (Bows & Anderson 2007; Le Queré et al., 2015)

5.5 Overview of initiatives and recommendations from partner universities

The online survey among peer universities in 2016 shows several options for emission reduction measures or compensation mechanisms (Survey ETH et al., 2016). Almost all institutions apply measures, which aim at reducing the carbon footprint of business trips. An overview of suggested and implemented measures and initiatives to reduce the carbon footprint from business trips of our partner universities according to preference from a survey are shown in Table 3.

Table 3: Suggested and implemented measures of partner universities

Measure	Description	Suggested or implemented
Regulatory measures		
Regulations on means of transport	Public transport (trains, busses) have to be taken for specific city connections up to certain distances	Mainly implemented for certain distances, suggestions for distances covered by train/bus
Compensation of carbon emissions	Applying compensation schemes where compensation payments are made to projects that reduce the effects of climate change, or internal compensation is possible	Not implemented in the big institutions, more on level of institutes
Systematic monitoring and reporting		
Non-regulatory measures		
Awareness raising campaigns and initiatives	PR campaigns or letters with recommendations and advice	Only some universities have targeted campaigns
Advice or recommendations	Supportive advice instead of regulations (e.g. decision tree for justification or travel management consultancy)	
Changes in enabling conditions		
Infrastructure for high quality VC technology	Videoconferencing technology in order to hold virtual meetings or collaborate online	At almost all universities, many have dedicated room systems
Tools to compare travel options	Tracking tools, considering various means of transport and different priorities such as price, travel and carbon emissions	Many universities have such systems available but not in a very systematic or structured way.
Expense reimbursement policies	Impacting and steering choices of business trips through reimbursement systems	Mainly in small institutions
Centralized travel booking office		

Out of the 34 reported universities, 21 higher education institutions had measures in place which aim at reducing the carbon footprint of business trips:
The majority of the surveyed institutions systematically collect information on business travel and monitor national and/or international business trips of staff, including the transport mode, especially the big universities in the IARU network like ETH, UCT and University of Oxford. They report because of different reasons such as top-down pressure or own motivation but often do not really make use of the data afterwards.
Most popular are activities related to increasing the quality of video conferencing tools and infrastructure, followed by awareness raising campaigns and initiatives and internal regulations that public transport has to be taken for specific city connections or up to certain distances. Some of the universities provide or recommend to use tools to compare travel options, considering various means of transport and different priorities such as price, travel and CO_2 emissions (e.g. routeRANK[6]). Few universities also apply expense reimbursement policies that have an impact on steering choices linked to business trips. One of the universities in the IARU network provides measures for compensation of CO_2 emissions while another university offers travel management consultancy. Some other institutions provide loose guidance or advice instead of rules or regulations, e.g. suggestions for distances to be covered by train. On the other hand, only four out of 21 institutions support compensation or offsetting of CO_2 emissions. It is also interesting to note that more than 20 out of 38 of respondents do not know if their institution would allow for external supervisors to participate via video conferencing in a PhD or Master Thesis defence. This implies that institutions for higher education still have a rather high unused potential to use video conference systems for lecturing, research commissions or PhD- and Master defence settings. Other approaches were mentioned as well and many of them are only followed to a limited extent or just starting in 2016 or 2017, such as systematic monitoring and reporting schemes for business travel. To confirm these first results, further and more detailed information needs to be collected.
Of all the suggested categories and measures some have been proven to be more successful according to literature. In order to mitigate negative impacts on climate, many possible measures and strategies with varying success rates were mentioned in literature. Carbon accounting for providing transparency, accountability and support for decision-making such as proposed by Schaltegger and Csutora (2012) seems promising but it is a lot of effort to generate, collect and analyze this data. Furthermore, the measures that are created based on the data then also have to be implemented. Additionally, such assessment methods are mainly in place for supply chain management, production planning etc. but they are not used that often for analyzing the impact of business travel for academia.

6 Conclusion

A university thrives on the exchange of knowledge and cooperation between its own members and with other educational and research institutions. International collaboration and networking are often strategic targets of universities. While business trips help develop and embed academic research, collaboration and learning – we must ensure that this is balanced against the commitment to reduce overall institutional carbon emissions. Hence, we face a conflict of strategic targets and interests. We hereby determine the main conflict to be addressed between the international orientation of universities and their commitment to reduce institutional carbon emissions of universities.
Our literature review shows that there is a growing number of scientists who address the dilemma and call for action. However, there is not enough data provided by literature or partner universities in order to clearly state how flight miles in the academic environment can be reduced significantly and credibly.

[6] https://www.routerank.com/fr/

There are mainly cultural and organizational factors that make most scientists think that they need to fly frequently to be successful in science (such as peer pressure, and the scientific evaluation system). Flying has become common practice place and is part of the culture of academia as mentioned by Le Queré et al. (2015). For this reason, a cultural change is needed that has to come from inside the university community. We think that it is time to open a constructive dialogue about air travel at universities. There has to be an open and critical exchange of experiences between differently targeted interest groups (researchers, students, administrative employees and university management).

According to our survey, most partner universities are technically well equipped and could hold more virtual meetings than they actually do at the moment. Therefore, we postulate that it is also primarily a matter of psychological, cultural and organizational factors why the potential of virtual collaborations in science is not fully utilized yet, such as mindset, insufficient personal video conference experience, high organizational efforts for setting up video conferences with many partners. We believe that the potential of virtual communication and collaborations in scientific research is not fully utilized yet and there is huge potential in reducing related business trips and thus overall institutional carbon emissions. Our main question is: “Does successful science need frequent flyers?”

To open this discourse, we initiated the project “Virtual Conference” to test a new virtual conference format in an experimental pilot study within the IARU network of leading research universities where scientists convene to discuss the dilemma of frequent flying and the objective of air miles reduction.

We want to connect and bring together a critical mass of “suffering” universities in order to foster an open critical discussion within the scientific community and in order to deduct general advise for improvement based on this. The goal of the Virtual Conference is to jointly produce recommendations on how to reduce CO_2 air travel emissions. These collected recommendations and measured shall be combined in a Policy Brief that is published after the event.

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Appendix

Appendix A: Videoconferencing Technology

A variety of technologies that provides audio and video connection at the same time are available. The provided videoconferencing (VC) technology can be divided into four practical categories, considering its complexity and reach:

- Laptop-based or desktop-based with video camera
- Meeting room, view on all
- Meeting room, zoom in on active speaker
- Room-based solutions

Table 4: Categories of available VC technology

Category	Description	Example	Pros	Cons
Laptop-based or desktop-based with video camera	Laptop/Desktop Computer Webcam Headset Microphone and Speakers	Skype, Google Hangouts, Facetime, Facebook Call, Cisco Spark	- Easy setup - Cheap - Available on many devices -Individuals may remain in their office or at home	- Low quality - Distraction - Interruption - Many services, hard choice
Meeting room, view on all	Camera installed in a meeting room, one screen in the front	Any webcam and screen, many operators, Telepresence operator	- No special system needed - Cheap - Easy to build - Low maintenance - Recording and streaming	- Distraction by seeing yourself - Faces are small - Emotions hardly visible
Meeting room, zoom in on active speaker	Several cameras in a meeting room, one screen in the front, active speaker tracking, cloud conferencing	Cisco Telepresence, many solutions, e.g. Cisco WebEx, Telepresence	- Real-life experience - High quality - Closed-up view on people - Pretty high quality - Open interfaces	- Some people don't like the zoom-in - Can be a bit small for multiparty conferencing
Dedicated room-based solutions	Fully equipped room, frontal camera line (min. 3 cams and 3 screens), for around 10-50 people	Cisco new solutions, Video Conferencing Gateways with Video Conferencing Server (VCS)	- Optimal for screen sharing and presentations - Active speaker tracking, real experience - Comfortable, ease-of-use - Real-time	- Expensive setup - Installation and maintenance - Engagement of all people might be difficult - Conference centre: Participants must assemble in a room
High-end dedicated conference rooms	- More than three cameras and screens in the front - For more than 50 people	Cisco and other operators	- Very attractive real-life experience - Customized (size and price) - Up to 1000 people	- High upfront investment - Low cost effectivity - Exaggerated capabilities - Can be fully booked

Sources: Erol and Li, 2005; Web1-Web15 (respective web pages of the videoconferencing systems and services)

The following section provides an overview of available information about advantages, disadvantages and challenges or requirements related to this use of video conferencing systems:

Advantages

Besides the reduction of air travel and the hereby induced reduction of CO_2 emissions, the following advantages of video conferencing as a means for virtual collaboration are expected. Many benefits were pointed out in the working paper "Towards a culture of low-carbon research for the 21st century" by the Tyndall Centre for Climate change research: Hosting major conferences used to be a luxury typically only affordable to large corporations and businesses. Today organizations of all sizes and strengths are empowered by the internet and the reduction in costs to host their own conferences virtually (provided that they can create interesting, valuable and engaging content). This leads to the democratization of organizing conferences. However, it's not only about organizing conferences but also about attending conferences. If conferences are held virtually more people from around the globe can attend the sessions, leading to a fairer distribution of knowledge exchange and sharing. Furthermore, there will be more diverse inputs from different backgrounds at the conferences as more people can contribute to the content (Le Queré et al., 2015; Douglas et al., 2013).

Travel time and cost can be reduced dramatically. Video conferencing does not only provide a direct replacement for many in-person business trips, but there is also almost no cost for people to be involved in a virtual meeting. There are literally no time or spatial constraints as video conferencing can be conducted at any time of the day. Furthermore, everyone can actively participate in conferences or at least passively consume the recordings of the content after the conference from any location. These three factors increase accessibility of information and make content more readily available to a broader audience that is temporally and spatially distributed. Furthermore, meeting efficiency and productivity can be increased by eliminating time and barriers because meetings can be held anytime, anywhere with anyone. In this way, meetings are reported to be shorter and more efficient in resources such as time. As digital technology is developing fast, including various technologies of virtual collaboration, we have the opportunity to fly less without losing productivity and efficiency in meetings of research or project groups.

Disadvantages

As some meetings require a personal touch to be successful the lack of direct personal interaction in virtual communication and collaboration can pose problems. This is and especially important downside if creating commitment and trust are absolutely key for research or project success. Video conferencing can be less personal than meeting face-to-face, and it can be possible to miss out on vital body language and gestures when you're struggling with a pixelated image or stuttering video or when you just see the faces of meeting participants. In this context, misinterpretation of gaze direction ("virtual squint"), misinterpretation of pointing gestures due to the missing common physical environment, difficulties to refer to physical objects and locations and misinterpretation of atmosphere in a group due to a missing "long shot" can pose additional problems. Additionally, technical problems should not be ignored: The major disadvantages are the technical difficulties associated with smooth stable transmissions that could result from software, hardware or network failure. On some occasions, the absence of technical support personnel creates difficulties for participants who are unfamiliar with the videoconferencing technological concepts and don't know how to overcome technical issues such as shaky or pixelated images or interrupted audio layers.

Challenges

Differences in time zones have to be taken into account when planning and conducting the virtual meetings. In distributed teams you communicate regularly with people in other countries. Different time zones participants are located in can make it challenging to find appropriate suitable meeting

times which are during officially accepted working/office hours for all participants. Cultural differences impact on communication and different cultural backgrounds have to be taken into consideration.
Computer-based systems are used for enhancing distributed collaboration between individuals who are geographically or temporally distributed. The goal is to closely simulate face-to-face collaboration by replicating the full range, level and intensity of interpersonal communication and information sharing as if the participants were not separated. Real-time video technology plays an important role in supporting interpersonal communication and exchange for a fruitful collaboration at distance. Audio and video signals are combined to coordinate the content and process of conversations. Video serves as a supplement to audio in order to enable non-verbal communication by transmitting subtle, subconscious and complex visual cues such as eye contact and body language. These provide additional information to spoken words and explicit gestures (Ludwig et al., 2007).
For a successful video conference, providing perfect equipment on one side is not sufficient. Instead, one needs adequate equipment at all participating locations. One party mainly invests in the own video conferencing equipment to enable the other side to see and hear better, not for improving the own user experience. So building trust and providing excellent local technical support are very important for holding a satisfying video conference.
Additionally, video transmission also provides an important addition in order to evaluate communication availability and ability of the participants in a video conferencing session. Video might play another important role for communication as visual interaction is vital to build a connection and trust between people. Furthermore, video helps to share visual information to enable exchange over work objects and tasks by building up a shared workspace, used to simulate a shared physical environment. This has implications for synchronization and bandwidth allocation (Whittaker, 1995).

Video Conferencing software/ technology at IARU Universities

A short analysis of video conferencing systems that are available at and supported by the IARU universities delivered the following results:
Many universities in the IARU network support Skype Business, Adobe Connect and Cisco WebEx services. Furthermore, many of these universities offer customized systems or other desktop- or laptop-based telepresence and video conferencing systems that are available for free up to a certain number of meeting participants. The most commonly used systems or services are blue jeans, google hangouts and skype. (For more information see their homepages and the document “IARU Universities Videoconferencing Technology”.)

Appendix B: Reasons for Conference attendance

Motivators and expectations for conference attendance are very diverse.
So why do people attend scientific conferences? There are several expectations of the attendees of conferences that have to be met in order to ensure attendance satisfaction.
The main benefits of face-to-face conferences are personal interaction or contact and networking. These lead to building of commitment and trust and conference attendees can meet new people. Further benefits or expectations that have to be fulfilled at conferences are the following: Many attendees enjoy exploring the world and different realities and they are interested in building up an international network and establish valuable partnerships. Such diverse contacts can lead to participation in international projects, cooperation and publications. Furthermore, work is presented at conferences. Unconditional exhibition or conference hall browsing are key for informal less arranged contact. Everyone can exchange ideas, expand the own knowledge and give feedback to others. Finding solutions together is a clear advantage of physical conferences because the potential of people in your field or outside your field is huge and assembled in one place, which can give researchers very valuable insights. Furthermore, one can learn beyond the own field of interest. All these points are especially important for young researchers that are not well established in the research community yet. This is key for prestige and success, international fame and respect.
Few publications treat the topic of choice of conference attendance and many of them do not directly relate to attendance of scientific conferences. According to Oppermann and Chon (1997), the main motivators to attend physical scientific conferences are networking or personal interaction and the program or setting of these conferences. Their model for decision-making concerning convention participation includes the following four factors with related sub-factors:

Table 5: Motivators to attend scientific conferences

Factor	Sub-factors
Personal or business	- Individual's health - Finance - Schedule
Business location	- Proximity - Travel costs - Climate - Destination image
Association and conference factors	- Level of career advancement by attending the conference
Intervening opportunities	- Other conventions or activities that might be substituted for a particular convention

Further research supported and elaborated upon the model by Oppermann and Chon (1997) mentioned above as follows. Additional factors that influence convention participation have been found: Activities and opportunities as well as program content that can provide educational value or support career enhancement play an important role in conference selection. Additionally, another key motivator for conference attendance is networking. Convenience and travel ability, which are influenced by travel costs or financial situation as well as infrastructure. Destination or location of the conference also have an impact on conference attendance. Furthermore, safety and health of participants have to be ensured at all times (Mair and Thompson, 2009; Severt, Fjelstul, & Breiter, 2009; Yoo and Chon, 2008, 2010; Yoo and Zhao, 2010).
In a modification of Oppermann's original scheme, Zhang et al. (2007) suggested to group these factors into the following four basic dimensions.

- Association and conference factors
- Location factors
- Personal and business factors
- Total cost factors.

The first three dimensions look similar to Oppermann and Chon's model (1997) but location factors are hereby divided into accessibility and attractiveness. Total cost factors include monetary and time costs and they include and expand Oppermann and Chon's "intervening opportunities" dimension or factor (Zhang et al., 2007; Tanford, Montgomery and Nelson, 2012; Yoo and Zhao, 2010).
Using a rigorous scale construction methodology, Yoo and Chon (2008) obtained support for the following five attendance factors:

- Destination stimuli
- Professional and social networking opportunities
- Educational opportunities
- Safety and health
- Travel ability (includes time, cost, and personal financial situation)

As an example, Tanford, Montgomery and Nelson (2012) conducted a survey at one convention for associations in order to identify the following diverse factors that influence convention choice:

Table 6: Factors that influence convention choice

Factor	Survey item
Program	- Interesting topic - Reputation of convention - Convention Program - Quality of exhibitors
Cost	- Cost of transportation - Cost of accommodation - Price of registration
Networking	- Generating new business - Renewing business contacts - Involvement in the association - Professional advancement - Networking opportunities
External activities	- Visiting friends and family - Visiting the surrounding area - Seeking employment - Required by the company - Attending with a friend or family
Location	- Accessible location - Attractiveness of location - Hotel facility

The most important factor is the program selection, followed by cost, networking and external activities such as visiting friends or family or the surrounding area. The final spot is occupied by location's accessibility, attractiveness and the accommodation offered. The factors and survey items are listed

according to decreasing importance. This model example based on survey answers of a sample of conference participants serves as a good overall model for understanding conference selection, attendance and selection.
In line with this, another study found the following:

Table 7: Motivational factor, facilitators and inhibitors that influence conference attendance

Top five conference motivations: - **Education** - **Networking opportunity** - **Interesting conference programs** - **Career enhancement** - **Opportunity to travel to desirable places.**	Underlying dimensions or attributes of motivation: - **Sightseeing** - **Self-enhancement** - **Business and association activities**
Conference facilitators: - Affordability and availability of time - Distance and ease of access	**Conference inhibitors:** - Conference and personal constraints - Distance, time and money.

These conference facilitators seem to play an important role in making a decision if a conference is attended and which one. On the other hand, certain conference inhibitors prevent people from attending conferences (Rittichainuwat, Beck and Lalopa, 2001).
This finding is consistent with previous studies on convention tourism (Price, 1993; Oppermann and Chon, 1997).

Appendix C: Initiatives to reduce CO_2-emissions from academic business trips by airplanes

Table 8: Initiatives to reduce CO_2 emissions from academic business trips by airplanes

Type of Initiative	Title	Institution	Contact	Link
Implementation Strategy	Tyndall Travel Strategy - towards a culture of low carbon research for the 21st Century.	Tyndall Centre for Climate Change	Corinne Le Quéré	http://www.tyndall.ac.uk/travel-strategy
CO_2-Calculator	Tyndall Travel Tracker	Tyndall Centre for Climate Change	Corinne Le Quéré	http://travel.tyndall.ac.uk/
Local Conferences linked globally with Virtual Conference	Effects of Internet-based multiple-site conferences on greenhouse gas emissions	EMPA University of Zürich	Vlad Coroama Lorenz Hilty Martin Birtel	http://www.sciencedirect.com/science/article/pii/S0736585311000773
Local Conferences linked globally with Virtual Conference	Innovative multi-hub Global Arts and Psychology Seminar April 28-29, at universities around the globe	University of Graz, Austria	Richard Parncutt	https://systematische musikwissenschaft.uni-graz.at/en/research/conferences/gaps2017/
Virtual Conference	Climate Change: Views from the humanities – A nearly carbon neutral conference	University of Santa Barbara	Ken Hiltner and John Foran	http://ehc.english.ucsb.edu/?page_id=12687
Virtual Conference	Second inspiring nearly carbon-neutral UCSB conference on “The World in 2050”	University of Santa Barbara	Ken Hiltner and John Foran	http://ehc.english.ucsb.edu/?p=15197
Virtual Conference 3D	Virtual Conference on Higher Education	IUNC network		https://www.iunc.net/conference/advantages/18
Blog	Academic flying blog	Tufts University Vassar College	Parke Wilde Joseph Nevins	https://academicflyingblog.wordpress.com/2016/10/21/flyingless-meetingwebinar-thurs-oct-27/
Petition	Call on Universities and Professional Associations to Greatly Reduce Flying	Tufts University Vassar College	Parke Wilde Joseph Nevins	https://docs.google.com/document/d/1URRRh4zMSpvtZY08F9-Rkbx0qkNNmfzIzqOlqZWKxkE/edit
Petition	Reduce flying to academic conferences	University of Graz, Austria	Richard Parncutt	http://www.parncutt.org/flying.html

Contact

ETH Zürich
ETH Sustainability
Stampfenbachstrasse 52 (STE)
8092 Zurich

virtualconference@ethz.ch

Publisher: ETH Sustainability